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Research on Value Creation of Engineering Project from the Perspective of Knowledge Creation Fusion—Based on Stakeholder Theory

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Abstract

In the era of knowledge economy, knowledge creation is closely related to the value creation of engineering projects. Project stakeholders have their own knowledge systems, and the value creation of engineering projects largely depends on the knowledge creation and sharing of stakeholders involved in the whole life cycle of projects. Based on the knowledge creation fusion perspective, this paper first analyzes the core elements of engineering project construction management and the main stakeholders involved in the whole life cycle. On this basis, a value creation model of engineering projects that integrate knowledge creation is constructed. In addition, its value creation mechanism is in-depth analyzed. The results show that the integration of knowledge creation and the whole life cycle of engineering projects essentially establishes a knowledge system, which gains competitive advantages and is conducive to long-term development by influencing the original behavior of stakeholder enterprises, and finally solidifies into an enterprise value system. The created engineering project value creation mechanism based on knowledge creation is composed of the value recognition, value proposition, value fusion, value realization, and value communication of the stakeholder enterprise. Through this interactive mechanism, all enterprises jointly create, transmit, and maximize the comprehensive value of the engineering project.

Keywords Knowledge creation · Engineering projects · Value creation · Stakeholders · Comprehensive value

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Introduction

Project construction plays an important role in promoting social and economic development, and project value is the key factor to play its role. Therefore, creating project value and maximizing it are the mission of project management. Due to the whole life cycle of a construction project involves many stakeholders, and different stakeholders are likely to conflict in order to satisfy their own interests and required value. For this reason, the realization of the value of construction projects and reasonable recognition are crucial. However, in recent years, researchers' perceptions of high-efficiency value creation methods for construction projects have fluctuated significantly. The in-depth development of knowledge creation research provides a new perspective for the value creation of engineering projects. Under the new normal of economic development, knowledge has gradually become the core strategic resource for enterprises to gain competitive advantage and business performance (Wang, 2019). How to integrate the concept of knowledge creation in the social network composed of stakeholders and integrate existing resources efficiently is an important idea for the value creation of engineering projects. It is also a major problem urgently to be solved in project management.

Research shows that the creation and internalization of knowledge by stakeholder enterprises of construction projects can effectively enhance the creativity and core competitiveness of enterprises and promote their success. Specifically, effective management of knowledge, such as summarizing, refining, sublimating, and reorganizing existing knowledge to create a new knowledge structure suitable for enterprise development, can improve project performance and competitive position. Many existing scholars pay attention to the importance of value creation in construction projects. And there are many studies discussing ways to enhance the value of projects. For example, optimize the allocation of existing resources such as manpower, capital, and technology (Fu & Ding, 2007), and build a rational model of stakeholder value allocation (Qi & Zheng, 2015). However, from the perspective of integrating the concept of knowledge creation, there are not many studies on the mechanism of project value creation. Therefore, this paper is based on literature reading and review. It first reviews the relevant theories of value creation, and then analyzes the main stakeholders and their roles in the life cycle of construction projects. On this basis, combined with existing knowledge creation research, the concept is integrated into the construction project value creation process. Then, construct a value creation model for engineering projects with a knowledge creation fusion perspective. Finally, analyze its value creation mechanism in depth based on stakeholder theory, with a view to providing reference for engineering projects to maximize value. The originality of this paper is to integrate the concept of knowledge creation into the corporate culture, strategic system, and the whole life cycle of engineering projects of all stakeholders from a new perspective, and put forward that the value creation process of engineering projects is composed of five stages: value recognition, value proposition, value fusion, value realization, and value communication

of stakeholder enterprises. This study helps construction enterprises to achieve the objectives of project cost, schedule, and quality; improve the comprehensive value of project performance, stakeholder satisfaction, and effective performance; enhance the core competitiveness of enterprises; and create a high-quality development environment for stakeholder enterprises.

The article is structured as follows: the "Literature Review" section introduces the relevant research status of value creation based on engineering projects, stakeholders, and knowledge creation; the "Methods" section describes the research methods of this article; the "Analysis of Core Elements of Engineering Projects" section analyzes the core elements of engineering projects; the "Model Building" section presents value creation model of engineering projects from the perspective of knowledge creation integration, and analyzes its value creation mechanism in depth. In the "Conclusions" section, we examine the implications of the results.

Literature Review

The literature shows that representative theories involved in value creation of engineering projects include stakeholder theory and enterprise value chain theory. The value chain theory was first put forward by Michael Porter, who believed that the value chain is an activity that creates value in order to produce valuable products for customers. There are two main ways to add value to enterprises: One is that all stakeholders involved in the value chain increase the value by creating through their own efforts, thereby realizing the value added of the entire value chain; Another is that stakeholders minimize transaction costs and maximize operational efficiency through mutual coordination and cooperation, so as to realize the value added of the entire value chain. The value chain of a construction project involves value creation and value-added in a series of project stages including project decision-making, design, construction, operation, and maintenance. The stakeholders involved in the process include the owner, designer, constructor, supervisor, material and equipment supplier, operating owner, and management department. Nowadays, the value management theory of construction projects covers not only the value of the project itself, but also the value of project stakeholders.

Value Creation

Professional engineering project management can realize the value of engineering project management and create value for engineering project stakeholders. As an efficient management technology, value engineering can be organically combined with engineering project management to improve management efficiency and realize the necessary functions or performance of the project. Many scholars focus on the research of value creation. The research mainly focuses on the discussion of the essence of value creation, the application of value engineering principles, the analysis of value creation models, and the methods of value creation ability enhancement. Wang (2010) proposed that the essence of value creation is the process of

"knowledge creation" for achieving effective performance, and it is the result of various stakeholders' complementary cooperation "creating." Tian and Chen (2005) believe that the value creation of stakeholders is closely related to the source of innovation, and innovation can only be achieved when the value and interests of stakeholders are met. In terms of the application of value engineering principles, Cong et al. (2019) applied value engineering principles to straw rural clean heating technology, and analyzed the value of various models to provide an important reference for the promotion of this technology. Based on the original value engineering principles, Li and Liu (2019) proposed to introduce schedule and risk assessment in the optimization of highway engineering design schemes, which is conducive to project stakeholders' selection of schemes. For the value creation model, Chu (2017) built a 5P model of smart city value creation, and emphasized the importance of stakeholder creating, delivering, and realizing value for the successful construction of smart cities. Based on the theory of quality improvement, Liu (2015) built a value creation model under the continuous improvement of the quality of stakeholder relations. Wang (2013) integrated the concept of social responsibility into the enterprise's value creation model and deeply analyzed its internal mechanism. Lin et al. (2013) discussed the key capabilities of service-oriented enterprises and clarified the important role of creating value from the perspective of customers. Magni et al. (2020) constructed the value co-creation model of higher education institutions, and discussed the driving factors of students' participation and the structural dimensions of value co-creation in higher education institutions. By investigating the driving factors of intellectual capital, Rossi and Magni (2017) discussed the relationship between the main sub-dimensions of intellectual capital and value creation activities. Willumsen et al. (2019) believed that engineering risk management could create value, then put forward the viewpoint of strategic value, engineering level value, and more "process-oriented" value, finally measured engineering value through cost overrun, engineering performance, and customer satisfaction. In order to enhance the ability to create value, Fu and Ding (2007) proposed the integration of various resources and advocated enterprises to carry out value activities. These studies have laid a methodological foundation for the following research on value creation of engineering projects.

Stakeholders

Hu and Liu (2019) believes that the difference in subjective value orientation among project stakeholders will cause cognitive bias, which will lead to the risk of engineering social stability. A large amount of literature shows that existing scholars have not only studied the definition of relevant concepts of stakeholders, but also conducted in-depth research on the classification of stakeholders. Chen and Qin (2015) believe that any group or individual that can affect the achievement of the overall goal or be affected by it is a stakeholder. Stefan (2007) has narrowed the scope to a certain extent, and believes that stakeholders have invested some physical capital, human capital, financial capital, or other valuable things in the enterprise, and thus have undertaken some forms of risk. Due to the relevance of the different

roles it plays in the enterprise system, it is considered to be an important part of the enterprise (Isenberg, 2010). Generally speaking, stakeholders have different interests, needs, and opinions, and their power and interests should be in a relatively balanced state (Freeman et al., 2010). When deviating from this state, various stakeholders will choose to adopt speculative behavior. Stakeholders of a project refer to individuals and groups that exist in the project environment to obtain corresponding rights to the successful function of the project, where corresponding rights refer to one or more stakeholders with rights, legality, or urgency characteristic. As many types of rules limit the bidding process, stakeholders have very limited opportunities to participate in projects, especially for PPP projects (Nederhand & Klijn 2019). Zhang and Yin (2013) emphasized the interaction between stakeholders and projects; that is, stakeholders refer to individuals or organizations that can have an impact on the project's goals and can be counterproductive by the project's goals. It will also gain profits or bear corresponding losses due to the implementation of the project. In general, the relationship with the organization or project is the core of the definition of stakeholders (Chen, 2017). Clarkson (1995) divided stakeholders into primary stakeholders and secondary stakeholders according to the closeness of the relevant individuals or collectives to the enterprise, but their attributes are the same. Mitchell and Wood (1997) believe that stakeholders must have one of the attributes of legitimacy, influence, and urgency, and according to this, they can be divided into three types: definite, expected, and latent. Chen and Jia (2004) divided them into core, dormant, and marginal stakeholders based on the initiative, importance, and urgency of interest requirements of stakeholders.

Knowledge Creation

Knowledge is a valuable, scarce, and incompletely imitable special resource that determines the competitive position and operating performance of a company (Wang, 2019). Knowledge creation is a kind of high-value and unique information formed through knowledge exchange and combination. Today's research on knowledge creation mainly involves the process of knowledge creation, the influencing factors of knowledge creation, and the application of knowledge creation. Yang and Hu (2018) found that knowledge creation is achieved through the synergy of horizontal and vertical spirals. Caputo et al. (2021) found that in the process of knowledge creation, employees' perception of internal organizational assets and environmental dynamics will have an impact on employees' knowledge hiding tendency. Zhuang et al. (2019) introduced knowledge spillover coefficients, marginal returns, and other variables to build a collaborative knowledge creation model to provide a reference for determining knowledge input policies. Huang (2011) believes that the key to creating knowledge lies in social practice and social interaction, and builds an organizational knowledge creation model based on a constructivist perspective. Based on the SECI (Nonaka & Takeuchi, 1995) (socialization, externalization, integration, internalization) process of organizational knowledge creation, Kang (2018) reconstructed existing knowledge to form a value chain model driven by innovation. There are many factors that affect knowledge creation, and the main points

of view are as follows. Age heterogeneity is not conducive to knowledge creation, and differences in education levels have a positive impact on knowledge creation (Xiang et al., 2019). The personal growth motivated by the team members and their environment have a significant positive impact on the knowledge creation of the team (Feng & Liu, 2018). The open innovation model has an inverted U effect on enterprise knowledge creation (Li et al., 2016). The knowledge-base compatibility existing among the cooperative enterprises (Ho & Ganesan, 2013) can improve the knowledge creation performance among enterprises through knowledge transfer (Li et al., 2020). Knowledge-oriented leadership of project-based SMEs has a positive impact on knowledge management behavior and project innovation performance (Zia, 2020). The company's dependence on customers' resources will affect its internal knowledge creation, and the overall U-shaped relationship appears, and the more critical resources the company obtains from its environment, the more significant its impact is (Sheng et al., 2018). Lv et al. (2017) found through empirical analysis that the relationship strength between enterprises is significantly positively correlated with corporate knowledge creation, and compared with contractual cooperation, equity-based cooperation is more conducive to corporate knowledge creation. Ojo et al. (2014) found that micro individual antecedents and social context have a significant impact on the ability of joint engineering project teams to absorb and create knowledge. In terms of the application of knowledge creation, Qi and Xu (2016) emphasized that the ability of knowledge creation can improve the innovation ability and competitiveness of enterprises, but it is necessary to ensure the integrity of the entire process of knowledge creation and the coordination of each link. Wu et al. (2015) applied knowledge creation to the technological innovation of enterprises, and found that in the early stages of establishment and growth of the enterprise, knowledge creation plays a significant role in promoting it. Guan and Xie (2016) showed that customers' knowledge creation ability can effectively promote innovation in tourism services.

In summary, the value creation of engineering projects is not only a problem of economic or technological creation, but also the impact of engineering projects on society and stakeholders in the whole life cycle. It is a complex process of multi-agent, multi-stage, stakeholder enterprises, and stage interaction. Because the project involves many stakeholders with complex relationships, in the project value chain, different stakeholders first increase the value it creates through their own efforts, and second, minimize transaction costs and maximize operational efficiency through mutual coordination and cooperation, so as to realize the value added of the whole value chain. Therefore, more and more scholars pay attention to the importance of value creation of engineering projects, which is different from only focusing on the cost, schedule, and quality of traditional engineering projects, but taking into account the multi-party needs of different stakeholders, striving to maximize the value of engineering projects and improve the efficiency of resource utilization, in order to jointly achieve the comprehensive value goal of stakeholder satisfaction and effective performance. The existing literature is more mature in the research on the essence of value creation, the application of value engineering principles, the analysis of value creation models, and the methods to enhance value creation capabilities. The relevant concepts and classifications of stakeholders are also relatively

clear. The research on the process, influencing factors, and application of knowledge creation has become more in-depth. However, in the era of knowledge economy, knowledge creation is closely related to project value creation. Project stakeholders have their own knowledge systems, and project value creation depends largely on the knowledge creation and sharing of stakeholders involved in the whole life cycle of the project. Knowledge creation has become a key element for enterprises to obtain and maintain competitive advantages. At present, considering the integration of the concept of knowledge creation, the research on the value creation of construction projects from the perspective of stakeholders is still in the initial stage of development. The exploration of the mechanism of knowledge creation on the value creation of construction projects is obviously insufficient, and it is more worthy of further study to maximize the value of the whole project by taking into account the common interests of stakeholders.

Methods

Literature research method is a method to obtain information through investigation of literature according to certain research purposes, so as to comprehensively and correctly understand and master the research problems. Qualitative analysis methods can go deep into the specific situation, understand in detail all the information related to the event, such as the occurrence background of the event, and finally form the most representative conclusion of the specific situation. It is a natural research method that follows the dynamic development of things, highlights the subject status of the researchers, and has strong explanatory and inductive nature.

In this paper, with the help of Internet database resources, a large number of literature on value creation, especially the value creation of engineering projects, are reviewed, analyzed, and summarized in detail, so as to fully digest and absorb relevant theories and research results at home and abroad. Through qualitative analysis, the literature is qualitatively analyzed, and the value creation model of engineering projects is finally constructed. Overall, it is a theoretical article; the specific process is as follows:

1. With CNKI and Web of Science as the main databases, and with knowledge creation, value creation, and stakeholder theory as keywords, the relevant high-quality core journal articles are retrieved.
2. The retrieved literature is preliminarily screened, and the literature related to the project, published after 2010, and consistent with the theme is selected. Figure 1 shows the trend of the literature related to the theme of this study. The results show that with the passage of time, the number of papers related to value creation and other topics increases significantly, and people' s interest and attention in related research are increasing.
3. Using qualitative research methods, trying to understand the nature and characteristics of project value creation. Firstly, the relevant parts of the project in the selected literature are preliminarily systematically sorted out. From the perspective of knowledge creation and integration, this paper analyzes the core elements

Fig. 1 Evolution of publications about related literature per year (2010–2020)

of project construction management, introduces the concept of project life cycle, and discusses the main stakeholders involved in the whole process; secondly, build the project value creation model of knowledge creation fusion; finally, drawing the value creation mechanism diagram of the project from the perspective of knowledge creation integration, in-depth analysis of its value creation mechanism, in order to make up for the shortcomings of existing theories and methods in this regard.

Analysis of Core Elements of Engineering Projects

From the establishment of the project to the acceptance of the project, the entire process is accompanied by different participants at different stages, showing different characteristics. The core elements of the project run through the life cycle of the project.

Project Whole Life Cycle

Before thoroughly analyzing the core elements of an engineering project, it is important to understand the whole life cycle of the engineering project. Different types of projects have different life cycle divisions. Tang (2018) proposed that general engineering projects can be divided into decision-making stage, implementation stage, and operation stage. Zhang et al. (2013) believe that the whole life cycle of large-scale engineering projects includes the project initiation phase, design phase, construction phase, use phase, and demolition and renewal phase. In view of the above division of the project life cycle, this study divides the project life cycle into four phases, namely the decision-making phase, design phase, construction phase, operation, and maintenance phase.

The project decision-making stage mainly involves several important stages of work such as project initiation, goal setting, feasibility study, and project approval. The main participants of the project at this stage are the owner and the project decision-maker. In the project design stage, the design unit conducts the preliminary design, technical design, and construction drawing design of the project according to the requirements of the owner. The main participants are the owner and the designer. The construction stage is the basic stage of project construction, involving a large number of stakeholders, including the owner, the construction party, the supervision party, the material and equipment suppliers, etc. The operation and maintenance phase of the project plays an important role in the normal function of the project. The main participants are the operating owner, the management department, and the operating objects.

The Core Elements of Engineering Project Construction Management

The element value theory believes that a variety of elements participate in the construction and management of the project. And they all create value, but the manifestations are different. Therefore, to establish a value creation model for engineering projects based on stakeholder theory, it is necessary to determine the core elements of engineering project construction management. To this end, based on the analysis of the entire life cycle of the engineering project and combined with domestic and foreign literature, this paper adds new elements of research to analyze the core elements of the construction management of the engineering project. On the basis of the existing site management elements, other elements are integrated. Finally, 5 types of core elements come into being. The specific contents are as follows:

1. Human resources

   The results of the literature review indicate that human resources are a collective term for the ability and experience of physical workers and mental workers who can promote value creation. Engineering projects mainly include construction personnel and management personnel. It has two main impacts on the value creation of engineering projects: on the one hand, the lack of professional and technical ability of construction personnel has adverse effects on site safety and quality; on the other hand, whether the deployment plan formulated by the project management personnel in the coordination and management of human resources will affect the efficiency of human resource management. The quality of the management personnel directly affects the overall quality of the project. It is necessary to change its management concept through professional training, so as to optimize the management process and ensure the quality and safety of the project.
2. Materials and machinery

   Materials are materials, semi-finished products, accessories, raw materials, and other construction product materials. And mechanical equipment is production equipment, which has the characteristics of high efficiency and high technical content. They are an important material basis for the smooth progress of construction of engineering projects, and their management is the basis of construction

management of engineering projects. Before the equipment and materials enter the site and during storage and transportation, the quantity and quality must be ensured so that the construction of the project can proceed smoothly.

3. Technology

   Technology is the primary productive force of social progress. During the construction of engineering projects, the introduction of technology has improved the capacity of construction equipment, labor productivity, and engineering quality. Under the constraints of established resource conditions, carrying out purposeful planning, organization, coordination, and control of the various technical activities and technical work elements of the project can effectively improve the level of construction technology and reduce the construction cost to a certain extent. It is conducive to enhancing the comprehensive quality level, engineering technical service level of engineering project personnel, and the core competitiveness of enterprises.

4. Capital and environment

   Funds are the economic support of project construction and the guarantee for the smooth implementation of the project. The construction of the project needs to ensure that funds are in place in full and timely, and fund management can effectively improve the economic benefits of the project. The environment includes external environmental factors such as geology, temperature, and humidity in the project construction area and the internal working atmosphere. By creating a harmonious environment, the construction of the project can be promoted in a coordinated, orderly and efficient manner.

5. Cost, schedule, and quality

   Cost, schedule, and quality are the three key elements of engineering project management. They are interdependent and influence each other, and are the key basis for the smooth completion of engineering projects on schedule. Combining with the life cycle analysis of the project, the progress target is accompanied by the whole process of the project construction, and the improvement of the project progress management is helpful to the effective control of the construction indexes, the coordination of the construction quality and the progress link, and the improvement of the construction quality; cost control directly affects the economic benefits of the project. It is necessary to ensure that the cost of the project is controlled within a reasonable range, strictly follow the requirements of the plan, and reasonably control the construction cost. Quality assurance is the premise of project completion acceptance. Quality control reflects the management level of the project department and is the most important link in the whole project implementation process.

Model Building

Analysis of the Role of Stakeholders

The stakeholders involved in the process of project construction management mainly include the owner, the designer, the constructor, the supervisor, the material and

equipment supplier, and the operator. Due to the long construction period of engineering projects, different stakeholders have different roles and functions. Zhao (2019) found that the owner and the builder are the core stakeholders in the construction management of the project. The owner manages the entire process of construction management of the project, and is committed to achieving the safety, investment, schedule, and quality goals of the project. As the link bridge between other stakeholders, the construction party can enhance the mutual trust between various stakeholders through its own effective coordination, which promotes the efficient construction of engineering projects. The designer plays a role that cannot be ignored in the early stage of engineering construction, and the concepts implemented in its planning and design directly affect the performance of the entire project. Based on the commission of the owner, the supervisor supervises and controls the construction quality of the project within the scope of authorization. Material and equipment suppliers are operators who are in line with the market during the construction of engineering projects. The quality of materials and equipment provided by them directly affects whether the construction of engineering projects meets the standards. The operator is an important participant in the operation and maintenance phase of the project. They have specific requirements for the quality and performance of the project. Through the management of the project, they solve various problems in operation in order to enhance the social image of the project and promote the project long-term development.

Value Creation Model of Knowledge Creation Integration

In order to further analyze the mechanism of knowledge creation on the value creation of engineering projects, this study explores the profound impact of knowledge creation concepts on enterprises from the perspective of the corporate culture, values, and life cycle of various stakeholders. In view of the existing research, from the perspective of

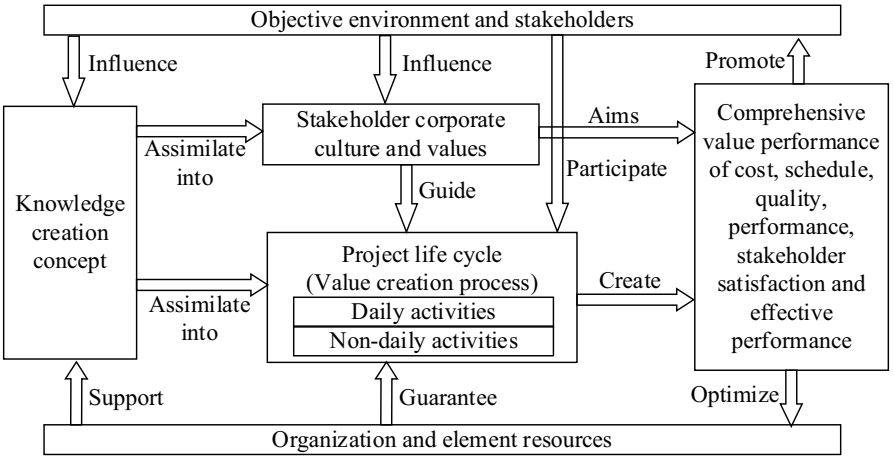

Fig. 2 Value creation model of engineering project from the perspective of knowledge creation fusion

knowledge creation fusion, build a value creation model of engineering projects driven by knowledge creation (see Fig. 2). The essence of this model is that deeply influenced by the objective environment and the needs of stakeholders, enterprises have deepened their understanding of the concept of knowledge creation, and gradually accepted this concept, integrating it into the corporate culture of stakeholders, value creation process, and engineering project life cycle. At the same time, various stakeholders provide corresponding organization and element resources in order to jointly achieve the comprehensive value goals of engineering project cost, schedule, quality, performance, stakeholder satisfaction, and effective performance.

First of all, the integration of the knowledge creation concept is easily affected by the objective environment of politics, society, system, and national policy. And the influence of stakeholder pressure and demand (Willumsen et al. 2019) cannot be ignored. Over time, the concept of knowledge creation has gradually penetrated into various stakeholder enterprises. The company realizes the important role of this concept and reflects it in corporate culture and values. As a result, the company's goals have also changed from initial cost, schedule, and quality control to comprehensive consideration of project performance, stakeholder satisfaction, and effective performance.

Secondly, under the guidance of the integration of knowledge creation concepts, corporate culture, and values, various enterprises are committed to integrating knowledge creation into the entire life cycle of engineering projects. This concept is integrated into the process of daily activities and non-daily activities in the construction management of engineering projects, which is actually the process of value creation. During this period, the participation of stakeholders can effectively promote the realization of value goals.

In addition, the in-depth knowledge of knowledge creation concepts, integration, and realization of the entire process of value creation require stakeholder enterprises to provide the necessary support. On the one hand, the establishment of internal organizational security system to strengthen communication and exchanges between various departments to ensure that all aspects of the construction are effectively controlled and coordinated; on the other hand, to provide the necessary elements of resources to ensure the knowledge creation-driven value creation process, such as human resources, materials and equipment, and technology and funds, these are the guarantee of project value creation and implementation.

Finally, the entire process of value creation in engineering projects can form a virtuous circle for the long term due to the enhancement of the corporate reputation of stakeholders. Enterprises with outstanding comprehensive value performance can generate a good reputation and gain recognition from the outside world, thereby enhancing the reputation of the company and creating a high-quality development environment. Internally, it can enhance the competitiveness of long-term development and improve the support and guarantee system.

Value Creation Mechanism

Based on the constructed value creation model and combined with existing domestic and foreign literatures, the value creation mechanism of engineering projects is

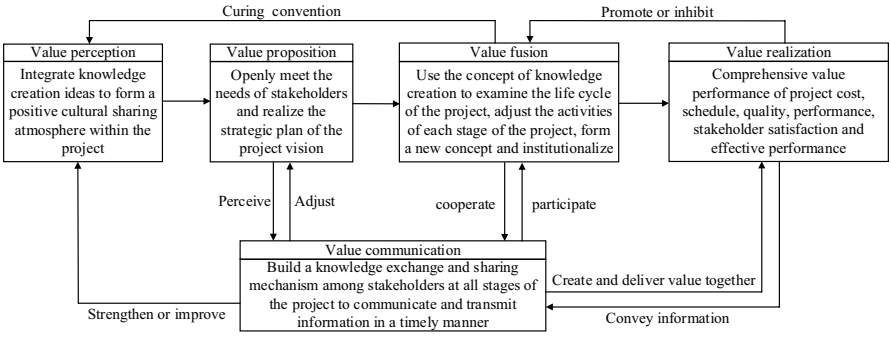

Fig. 3 The mechanism of value creation of engineering projects from the perspective of knowledge creation fusion

further analyzed. This study believes that the value creation process of engineering projects based on the knowledge creation fusion perspective mainly consists of five parts: value recognition, value proposition, value fusion, value realization, and value communication (as shown in Fig. 3). Stakeholder enterprises through this process co-create (Heredia Rojas et al. 2018), deliver, and maximize the comprehensive value of the project.

Value cognition refers to a series of forms such as publicity, training, and practice made by the stakeholders to make internal personnel's cognition of knowledge creation and project value creation consistent. The goal of integrating the knowledge creation concept in this process is to enable all personnel of the enterprise to develop the correct knowledge creation awareness and form a positive cultural sharing atmosphere within the project mainly by improving the original value system. The core values are the concrete manifestation of corporate culture, the soft power, and internal driving force of corporate development. It guides the corporate behavior and the philosophy of all employees (An & Du, 2019). On the basis of adhering to ethics and observing the law, the enterprise integrates the knowledge creation concept of project cost, schedule, quality, performance, stakeholder satisfaction, and effective implementation of comprehensive value optimization into values, forming an enterprise culture in which knowledge creation is the core competitive advantage. It influences each employee to make them perform actual behaviors, thereby affecting the behavior of the entire enterprise. In order to enhance all employees' recognition of the culture, enterprises can create a culture-sharing atmosphere through a series of activities such as regular training, knowledge competition, and distribution of learning materials. During this period, the needs of stakeholders will gradually emerge. Through the communication between them, they constantly improve the value concept, strengthen their effective performance, improve project performance, and then promote the value creation activities of engineering projects.

The value proposition refers to the strategic system in which the enterprise publicly meets the needs of stakeholders and realizes the project vision, and expresses the knowledge structure cognition. It is the embodiment of externalization of value cognition. The enterprise knowledge system under the integration of knowledge

creation is an important guarantee for enterprises to gain competitive advantage. The project vision is the target positioning of the company's long-term development, and the pursuit of the direction of all employees. The project vision guided by knowledge creation must not only ensure cost, schedule, and quality objectives, but also comprehensively consider the comprehensive value of project performance, stakeholder needs, and effective performance. After clarifying the project vision, it will be passed on to the society through media, public meetings, large-scale events, networks, etc. to let potential stakeholders understand the value proposition of the project and enhance their sense of identity with the project. To a certain extent, the correct value proposition can prompt stakeholders to reach a consensus with the project vision, and ensure that the construction management of the project will proceed normally throughout the life cycle. During this period, the value proposition that conflicts with actual actions can be continuously adjusted through the knowledge exchange and sharing mechanism among stakeholders at all stages.

Value fusion means that stakeholders use the knowledge creation concept to examine the life cycle of the project, adjust activities in various stages, form new behaviors, and gradually solidify, and finally achieve institutionalization. Only when the knowledge creation concept is integrated into all stages of the construction management of the project can specific actions be implemented. And then, the comprehensive value of the project's cost, schedule, quality, performance, stakeholder satisfaction, and effective performance can be maximized. Value fusion is the internal manifestation of the value proposition. At this stage, the knowledge creation concept is integrated into the daily activities and non-daily activities of the entire life cycle of the project. For example, in the engineering design stage, integrate the original knowledge of the designer, sublimate it, and innovate the design plan, so as to promote the realization of the project goals and improve the performance of the engineering project.

Value communication refers to the construction of a knowledge exchange and sharing mechanism among stakeholders at all stages to communicate and transmit information in a timely manner. In the process of engineering project value integration of knowledge creation concepts, value communication runs through the whole process. There are differences in the communication methods among stakeholders at different stages. Effective communication can promote continuous improvement in all stages of value creation. Common communication methods include information disclosure mechanism, temporary communication mechanism, and regular release of knowledge creation reports. The value communication link provides various stakeholders with an information feedback platform to promote their effective participation. Through the exchanges between them, they continue to strengthen their knowledge of the value creation of engineering projects with knowledge creation fusion perspective, and achieve improvements at all stages. During this period, they jointly create and deliver value, thereby optimizing the overall value performance of engineering projects.

Value realization is the externalization process of value fusion, and is the comprehensive value performance of engineering project cost, schedule, quality, performance, stakeholder satisfaction, and effective performance. It guides the stakeholders and determines their later actions. Only when this concept of value creation is

recognized by stakeholders, they will put the concept of knowledge creation into the process of construction project management. Through the refinement and improvement of existing knowledge, build a new knowledge system and promote the realization of the project vision, thereby enhancing the outside world's sense of identity of the project value created by the enterprise, and realizing the value creation of the project in the true sense. However, the value performance of engineering projects is a double-edged sword, and excellent value performance can increase the input of various stakeholders on the essential resources required for the knowledge creation fusion. On the contrary, it is difficult to be recognized by stakeholders at all stages and, to a certain extent, inhibit the value creation process of engineering projects.

Conclusions

After discussing the core elements of engineering project construction management, this paper analyzes the role of stakeholders involved in the project's entire life cycle, and builds an engineering project value creation model based on the knowledge creation fusion perspective. In addition, it deeply studies the mechanism of value creation of the engineering project after the knowledge creation concept is integrated into the corporate culture, strategic system, and project life cycle of various stakeholders. The main conclusion of this study is that the integration of knowledge creation and the entire life cycle of an engineering project is conducive to the realization of engineering project cost, schedule, quality, and performance goals, and creates a comprehensive value of stakeholder satisfaction and effective performance. The integration of knowledge creation and the entire life cycle of engineering projects is essentially integrated into the daily activities and non-routine activities of various stakeholders through the concept of knowledge creation, which affects the original behavior and practices of the enterprise, so that it builds knowledge system that gains competitive advantages and is conducive to long-term development. Eventually, the system becomes part of the corporate culture and values. The value creation process of engineering projects based on knowledge creation is composed of five stages: value recognition, value proposition, value fusion, value realization, and value communication of stakeholder enterprises. All enterprises jointly create value and realize the transmission and improvement of value through five stages of dynamic changes, and ultimately maximize the comprehensive value creation of engineering projects. During this period, the role of the knowledge exchange and sharing mechanism established in the value communication stage cannot be ignored. Various stakeholders communicate, promote the recognition of value creation ideas, and optimize actual behavior through this mechanism, which also has a certain impact on other stages of engineering project value creation.

The theoretical analysis in the research and the engineering project value creation mechanism integrated with the knowledge creation concept have important implications for the stakeholders to promote the maximization of the comprehensive value creation of engineering projects. In terms of economy, project construction, an important pillar of the national economy, is an important part of national infrastructure construction. And it is the government's main goal to maximize its

comprehensive value. With the continuous development of knowledge economy, it is self-evident that knowledge creation plays an important role in stakeholder enterprises' project performance and competitive position. Enterprises with knowledge creation as the core have developed rapidly in all countries, which has not only become the source power of economic growth in developed countries, but also the core force to promote economic growth in developing countries. Knowledge creation is a key resource that affects the competitive position of stakeholder enterprises. So, its concept integrated into the enterprise and practiced in the life cycle activities of engineering projects can improve the competitiveness of the enterprise. This is an important way to promote the comprehensive value creation of project cost, schedule, quality, performance, stakeholder satisfaction, and effective performance. This paper can not only bring pioneering new views and ideas to stakeholder enterprises, but also enrich enterprises' understanding of knowledge creation concept and value creation of engineering project, which is of great significance to improve the research on value creation of engineering project in China, but also to promote stakeholder enterprises to carry out systematic and scientific knowledge creation management plays a practical guiding role. However, in the actual management process, there may be problems such as insufficient value recognition of stakeholder managers, inconsistency of value perception and value proposition, and conflicts in the system. Therefore, it is necessary to strengthen the awareness of enterprise management personnel on value creation through training, evaluation, etc. to enhance the awareness of all employees of the enterprise. Establish a social supervision system to restrict the actual behavior of the enterprise. Solve the contradiction between internal and external regulations to accelerate the institutionalization process of the idea of enterprise knowledge creation. Strengthen the cooperation between stakeholder enterprises, so as to enhance the ability to integrate and utilize resources, and promote the optimal allocation of capital, human resources, technology, and other resources in the process of project value creation. The limitation of this research lies in the failure to put forward a quantitative analysis model for the value creation of engineering projects. Future research can focus on the value quantification model, and formulate the engineering project value creation model accordingly.

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